Task 0

Report on the Abstract prototype

Vehicle Detection and Tracking System using AI/ML Technique

Submitted By

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Introduction

In the past few decades researchers had a great interest in vehicle detection and tracking. They have tested a wide array of technologies in an attempt to find improved methods to avoid accidents in vehicles. Object detection attracted the attention in research industry lately. Researchers are trying to explore the topic to reach to an accepted accuracy level. Machine learning is used to detect objects as also different sensing modalities have been used for detecting the objects as specially for the vehicles. These modalities are LIDAR, radar, and computer vision. The attraction caused by immense progress in image processing. The detection of an object in video sequence plays a significant role in many applications Object detection is a fascinating field in computer vision. It goes to a whole new level when were dealing with video data. We can perform super useful high-value using object detection algorithms. The very first signs and models of image processing goes back to the 1960s' and 1070s', after that various methods and techniques have been invented and proposed. Due to lack of attention, Drowsiness, and drunk driving are the major causes of road accidents and tracking or to prevent theft kind Situations . this paper proposes preparing a system to prevent these circumstances.

Over the last decade, safety restraint systems in automobiles have progressively gained attention. This report is about Vehicle Detection and tracking System for the vehicle which helps to control the traffic flow also avoid the collision and prevent the theft of Vehicle. There are various means of monitoring traffic situations on roads. Due to the rise of artificial Intelligence based image processing technology, there is a growing interest in developing traffic monitoring systems using camera vision data.

This study provides a method for deriving traffic information using a camera installed at an intersection to improve the monitoring system for roads. Most of the road accidents occur due to distracted driving, aggressive driving, over-speeding,etc. Drivers fail to notice the presence of obstacles ahead and brakes need a driver's response to operate thus it increases the response time, hence reduces their reliability. The proposed work is to use the computer vision technique for detection and tracking of the vehicles. There are different techniques for object identification, they can be separated into two classifications, initial one is the algorithms dependent on Classifications. CNN and RNN go under this classification. In this classification, we need to choose the interested areas from the image and afterward need to arrange them utilizing Convolutional Neural Network. With tools like OpenCV, Yolo, Tensorflow this training data can be easily obtained to train the models. Using such data ML models can be trained on different algorithms. The Vehicle Detection using computer vision spots the vehicle to alert and avoid car accidents.

1.Problem Statement

To develop the Vehicle detection and Tracking system using Computer vision technique to avoid the collision of vehicles also to control the traffic flow and which can help to prevent the theft of the vehicles or if there is any breaking of traffic rule by vehicle.

2.Market/Customer/Business need Assessment

Detecting and tracking of the vehicles are among the most prevalent and challenging tasks that a surveillance system which can also get fitted in vehicles and has to accomplish in order to determine meaningful events and suspicious activities, and automatically annotate and retrieve video content.

As the Automobile trend increasing day by day there is increase in traffic which can leads to Various problems like travel costs, travel time, mobility, accessibility, productivity, and also impacts on the environment such as air pollution and global warming not only about the detection but tracking of the vehicles is Important as well.

So, the proposed system aims to solve such problems which can lead to save time, prevent theft situations if there is any breaking of traffic rule by vehicle and Road Accidents.

3.Target Specification and Characterization

The target of business is increase the productivity and better satisfaction of the customer.

a.Camera Quality

There should be good Camera Quality clearly visible pixel frames. Using high Quality is durable and under the customer requirements.

b. Vehicle Cost

As the vehicle is with Artificial Intelligence system so the Price may get high but as thinking about the customer need and value it should be affordable to the Customer.

c. Voice Assistant

There should be a voice assistant in the vehicle so that there will be proper guidance to people in vehicle. It can reduce the chances of road Accident.

d. Real time computer vision system

As the Condition is for real time there can be proper management of software as there should be no lag on the display Screen like have a faster FPS.

e. Assisted GPS (Global Positioning System)

For tracking of the vehicle GPS plays the main role. GPS is a system allowing satellite receivers to obtain information from communication network resources to assist in acquiring satellite location. A-GPS system is especially useful when the receiver is in a location where it is difficult for the satellite signals to penetrate. In addition to providing better coverage, A-GPS also improves the start-up time, which is the time required by the satellites and the receivers to establish a reliable connection.

4. External Search

1.https://www.hindawi.com/journals/jat/2021/4438861/

2.https://etrr.springeropen.com/articles/10.1186/s12544-019-0390-4

3.https://towardsdatascience.com/machine-learning-for-vehicle-detection-fd0f968995cf

4.https://iopscience.iop.org/article/10.1088/17426596/1634/1/012107/pdf

5.https://www.analyticsvidhya.com/blog/2020/04/vehicle-detection-opencv-python/

5. Bench Marking Alternate products

a. Tesla

Tesla made it clear that their system of cameras and radar is able to detect what an object or vehicle is. The radar looking forward is able to quickly tell if there is anything problematic ahead. Once an object comes into sight, cameras will decide what the object is and then the car can react to the situation.

b. Tata Motors

Tata Motors collaborates with WABCO India to further strengthen safety solutions for its commercial vehicles. **advanced Driver Assistance Systems (ADAS)** for medium and heavy duty commercial vehicles relies on sensors, such as radar and camera, to provide enhanced vehicular and occupant safety. Helping to mitigate driver error, these systems are capable of identifying a variety of different road traffic hazards to enhance driver and vehicle safety. Furthermore, integration of advanced driver assistance systems in the vehicle can help ensure the on-time delivery of goods by improving driver comfort and effectiveness as well as reducing accident downtime and related costs, for example.

6. Applicable Patents

a. US7764808B2 (United States)

https://patents.google.com/patent/US7764808B2/en

As Machine learning in Automobile has increase in its Trend. Machine-vision-based obstacle detection and tracking is an important component in autonomous vehicle systems. In a typical driving scene, the obstacles include vehicles, pedestrians and any other objects that are either moving or rising above the road plane. The purpose of obstacle detection is to separate moving objects from the driving scene, the obstacles including vehicles, pedestrians and any other objects that are either moving or rising above the road plane. Such information is required by a number of automotive applications, e.g., adaptive cruise control, forward collision avoidance and lane departure warning. By fusing the results of detecting and tracking individual objects, it is possible to achieve sufficient perception of the driving environment.

A number of approaches have been developed to address vehicle tracking and detection. One category of obstacle detection methods uses motion analysis. The true motion vectors of the road plane resulting from camera motion are estimated from camera parameters, position and ego velocity. When an object is violating the planarity assumption, a significant difference between the optical flow vectors calculated from consecutive frames and the true motion vectors (i.e., motion parallax) is detected, which indicates the appearance of an obstacle that is either moving or rising above the road plane. Other approaches group the optical flow vectors into clusters and track with a Kalman filter. With a calibrated camera and estimate of ego-motion, one approach can detect and distinguish between moving objects and stationary but elevated objects. In yet another approach, the clusters of flow vectors are further grouped into parallel lines on the rear face of an enclosing box, which correspond to the rear bumper of moving vehicles on the road plane.

b. WO2001075807A1 [WIPO(PCT)]

https://patents.google.com/patent/WO2001075807A1/en

This invention is related to a tracking and/or monitoring system for use in tracking or monitoring factors such as speed or location on vehicles such as cars or trains.
Traffic congestion on roads is becoming an increasing problem both on motorways and the like, and in town and city centres in particular. One of the main problems on motorways and other multi-lane roads is that many vehicle drivers remain in the overtaking lane, even when they are not overtaking another vehicle-, instead of

moving in to the inside lane. This slows following traffic, often causing unnecessary delays and holdups which would not otherwise exist. Congestion in town and city centres is caused simply by the volume of traffic. There have been many initiatives attempting to reduce the volume of traffic, such as "Park and Ride" schemes, subsidised public transport, car sharing, and so on. However, many people still drive their own vehicles into town and city centres, and congestion is ever-increasing because the number of vehicles on the road generally is always increasing.

7. Applicable Regulations

a. Clarification on Charging Infrastructure for Vehicle with reference to the provision of the electricity Act, 2003 (13th April 2018).

b. It is necessary to have a driver's licence to operate any kind of Motor vehicle. And EVs also are no exception. Without it, it's illegal to drive your vehicle on public roads.

c. As the proposed system included in Electric Vehicle. So about EV's Registration Fee in India- The Ministry of Road Transport and Highways (MoRTH) recently exempted electric vehicles from paying fees for a registration certificate. This recent development comes as major good news for all EV owners, as they will not have to pay anything for insurance or the renewal of their electric vehicles.

8. Applicable Constraints

Space:

The camera will fitted at top of the Vehicle and the display scree will be inside above the sound system. System will fit in Car space there should be no extension in the structure of the vehicle.

Expertise:

Mechanical Engineer

Machine Learning Engineer

Electronics Engineer

Data Analyst

Budget of Required Components:

Sr. no	Components required	No. of components	cost
1	360 degree rotation Camera	1	30000
2	Display Screen (1080p)	1	16000
3	GPS	1	5000
4	Ultrasonic Sensor	4	2400
5	Wires	20	1000
Total			54400

Total Budget of required components is Rs. 54400 excluding the software.

9.Business Opportunity

As the world is getting Digitalised there is vast increase in the trend of Automobiles with new Technology for the Safety of people. In the busy era Health and safety has become the important factor. The cases of Road Accidents are increasing day by day and theft kind of things also occurs.

Coming on the business the AIML based Vehicle Detection and tracking system is todays need of the world. As it helps to alert the driver prevent from Road Accidents and theft kind of Situations. Huge Traffic leads to numerous problems as related to health and safety. Detection and tracking system can alert the passengers in vehicle.

10.Concept Generation

As the cases of Road accidents and theft kind of situations are increasing day by day. There is high Road traffic flow which can leads to various health and other problems like travel cost, travel time, Mobility, loss in productivity and also impacts on the environment such as air pollution and global warming.

To overcome such Situations the Detection and tracking System in Vehicle using Artificial Intelligence and Machine learning technique comes into picture which can helps to save a life and health of the Drivers. This is not only help to prevent road accidents and also tracking of the vehicles. The best vehicle Tracking system provides features that help you keep good accountability regarding the usage of your vehicle.
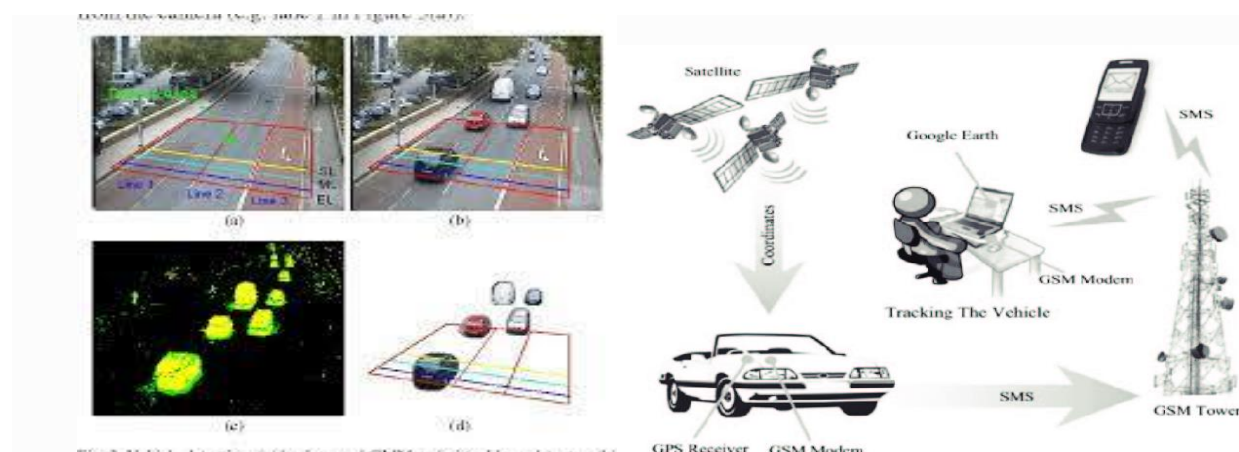
11. Concept Development

The concept is to develop the Detection and tracking System in Vehicle using artificial intelligence and machine learning technique.

1. Installing the software
2. Installing GPS module for tracking Purpose.
3. Proper Setting and fitting of the 360 degree Camera.
4. Setting of Voice Assistant to alert the driver.
5. Clearly visible display screen with 1080 pixel.
6. Fitting of ultrasonic sensors for detection of objects or vehicles.

12. Final Product Prototype (abstract) with Schematic Diagram

Abstract

Computer vision in machine learning dedicated to interpreting and understanding images and video. It is an interdisciplinary field that deals with how computers or any software can learn a high-level understanding of the visualizations in the surroundings. The detection of vehicles plays a crucial role to avoid car accidents and tracking system about the tracking if he vehicles. In order to detect the vehicles these machine learning models require high amounts of training data.

There are many software and libraries can used in Computer vision. Like YOLO, Tensorflow, OpenCV. OpenCV contains various tools to solve computer vision problems. There are many techniques doing this job. The given concept has been one using open CV library among the suggested models, this thesis is going to explore the topic on how to detect the objects and vehicles using OpenCV and setting of GPS module for tracking of the vehicles. Yolo works better in Real time Detection basically the version 5 of yolo is the latest version which is moe likely used for detection purpose.

Schematic Diagram
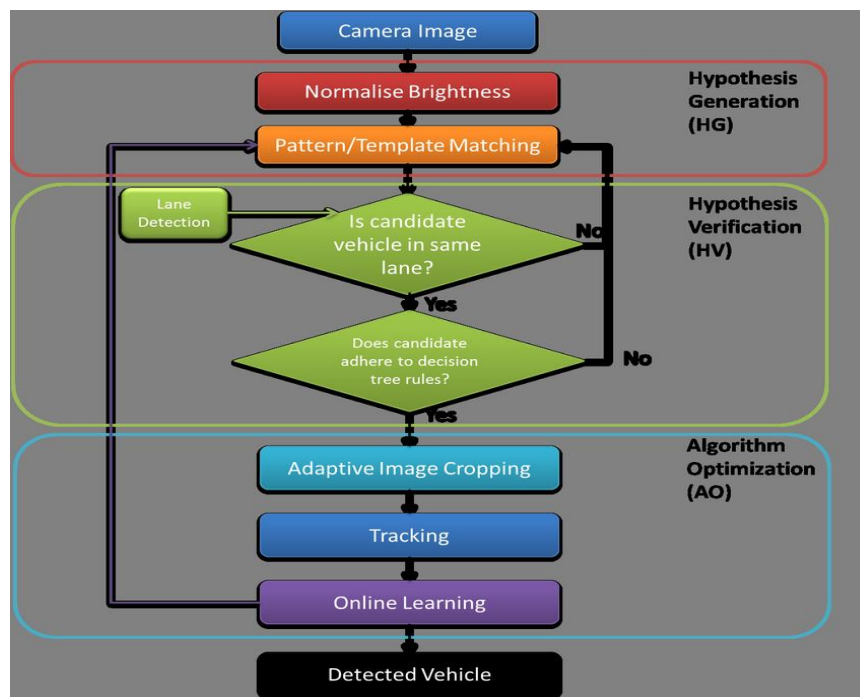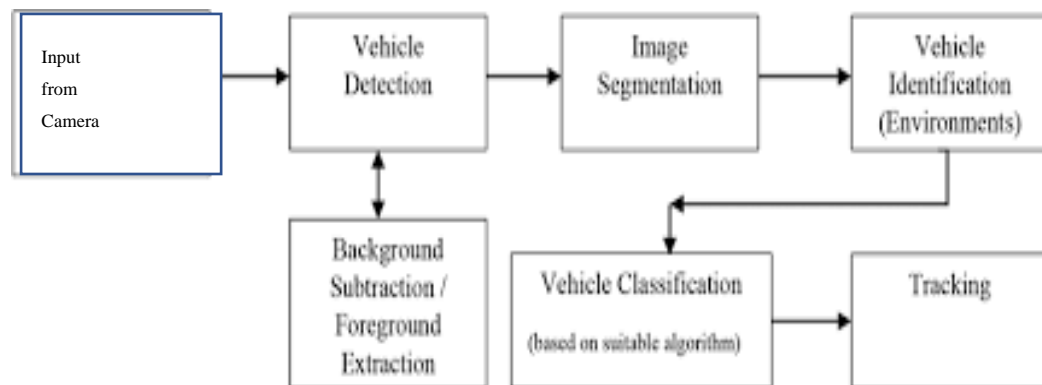
13. Product Details

How does it works?

Here the system will work using OpenCV library in Computer vision. OpenCV is open source library used in computer vision.

The camera will take input s video from real time and the video get converted into the frames using software there are steps to be followed for the Detection of vehicles.

The Implementation of Vehicle detection done using SVM (Support vector machine) Algorithm.

1.Feature Extraction from image

Feature extraction is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. The first and foremost thing which I did is feature extraction from an image. There are many features in an image which can be extracted and can help in training our classifier also called feature descriptor. One of the important Feature descriptor which i have used for Vehicle detection is HOG.

2.HOG (Histogram Oriented Programming)

The histogram of oriented gradients (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image.

3. Image Thresholding

Partitioning an image intro segments like image segmentation format which islates object by converting grayscale image to binary images.
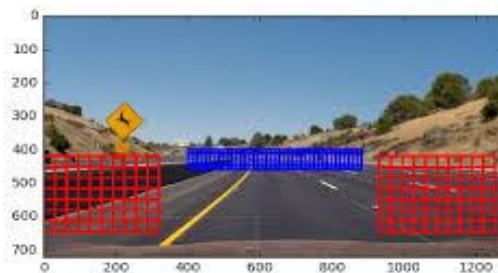
4.Using Sliding Window to detect cars

Now that classifiers are trained, use sliding window concept. For each of the region of the window, apply image classifier to check if the vehicle is detected on this region or not. Note that the size of car will vary depending on how far the car is from our car.
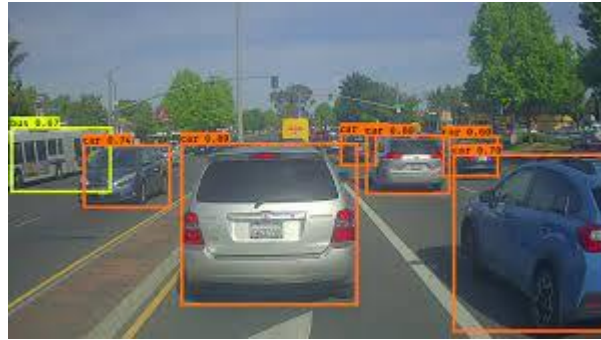
5. For the tracking system there is installation of GPS (Global positioning system) in the vehicle.

Data Sources:

As it is a real time data that is input video which will record by Camera.

Algorithms, frameworks, software etc. needed:

SVM (Support Vector machine Algorithm) used for the detection of Vehicles.

 Here, OpenCV library used for Computer vision done in PyCharm Software. The implementation done in Python3 Programming Language.

14. Code Implementation/Validation on Small Scale

```python
import cv2
cap = cv2.VideoCapture("Resource/surveillance.mp4")                          #Input as Video
#object Detection
object_detector = cv2.createBackgroundSubtractorMOG2(history=100, varThreshold=30)       #Background Subtraction
while True:
    success, frame = cap.read()
    height, width, _ = frame.shape                              #Height and Width of the Frame
    print(height, width)
    #Extracting the Region of Interest)
    Region = frame[10:360, 10:550]                             #Region of Interest

    mask = object_detector.apply(Region)

    #Creating mask on the Region of Interest
    _, mask = cv2.threshold(mask, 254, 255, cv2.THRESH_BINARY)
    contours, _ = cv2.findContours(mask, cv2.RETR_TREE,cv2.CHAIN_APPROX_SIMPLE)
    detections = []

    for cnt in contours:
        #Calculate the area and remove the small elements
        area = cv2.contourArea(cnt)
        if area > 50:
            #cv2.drawContours(Region, [cnt], -1,(0,255,0), 2)
            x, y, w ,h =cv2.boundingRect(cnt)
            cv2.rectangle(Region, (x,y), (x+w, y+h), (0,255,0), 3)
            detections.append([x, y, w ,h])


    print(detections)
    cv2.imshow("Region", Region)                               #Displaying the Detection on Region of Interest

    cv2.imshow("Mask", mask)
    key = cv2.waitKey(20)
    if key == 27:
        break

cap.release()
cv2.destroyAllWindows()
```
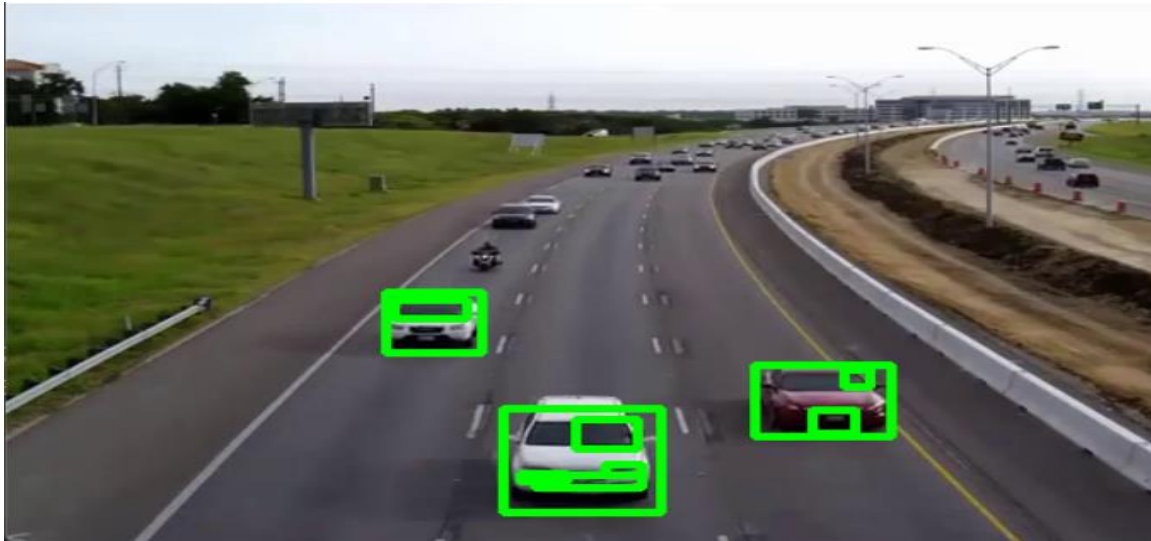
OUTPUT

Here is the detection of vehicle using OpenCV in computer vision in python programming language.

Available code on github:

https://github.com/kcg2015/Vehicle-Detection-and-Tracking

https://github.com/Toemazz/VehicleDetectionAndTracking

15.Conclusion

The proposed system helps to reduce in road accidents and theft kind of things. Tracking of the vehicle is an important part. As Safety is the most important factor the given system is now the need of the world. This can make the Automobile sector much advance and with good features. The system used opencv as computer vision technique which helps to detect the vehicles or objects whereas YOLO is also a one of better choice for real time detection.

16.References:

[1]Sipan masoud mustafa,Vehicle detection and tracking using Machine learning techniques, Nicosia 2019

[2] Raad Ahmed Had, Ghazali Sulong, Loay Edwar George. Vehicle Detection And Tracking Techniques: A Concise Review.

[3] https://me.tatamotors.com/en/press/tata-motors-collaborates-with-wabco-india-to-further-strengthen-safety-solutions-for-its-commercial-vehicles/

[4]https://voices.soundhound.com/the-future-of-voice-assistants-in-car-and-on-the-go/

[5]https://towardsdatascience.com/vehicle-detection-and-tracking-using-machine-learning-and-hog-f4a8995fc30a

[6]https://www.carandbike.com/news/rto-rules-for-electric-vehicles-in-india-and-all-guidelines-2730626